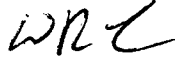


Memo

date: *October 3, 2002*

to: *T. Sheridan*

from: *R. Casey* 

subject: *TTB ARR*

Attached is the final report of the accelerator readiness review that has been performed for the routine transport of low mass ions from the Tandem Van de Graaf to the Booster (TTB). This review is in response to your request of May 9, 2002. This review was conducted in compliance with the provisions of DOE Order 420.2, *Safety of Accelerator Facilities* and the Brookhaven National Laboratory Accelerator Safety Subject Area.

It is the consensus of the ARR Team that the C-AD conducted a comprehensive review and all provisions of the safety assessment document are being addressed. Adequate controls and policies will be in place to transport beam safely from the Tandem to the Booster. In addition, C-AD has established limits for light and heavy ion operation in RHIC consistent with the approved Accelerator Safety Envelope and a process for review to ensure that operations are conducted consistent with it. A number of procedures and actions have not been completed at the time of this review that will need to be in place prior to the start of routine deuteron transport to Booster. This Team will monitor progress in completing these items and will recommend approval once all issues have been closed.

A closeout memo will be forwarded to you following our verification that all items identified in the attached document have been resolved.

Please let me know if you have any questions.

cc. E. Lessard (w/attachment)
 P. Kelley – DOE Facility Representative (w/attachment)
 H. Kahnhauser (w/o attachment)
 M. Davis - ARR Team Member (w/o attachment)
 T. Monahan - ARR Team Member (w/o attachment)
 S. Stein - ARR Team Member (w/o attachment)
 J. Wishart - ARR Team Member (w/o attachment)

Attachment

ARR for Operation of the TTB Line with Low Mass Ions

Operation of TTB Line with Low Mass Ions

Accelerator Readiness Review

September 30, 2002

Signature Page

A committee, consisting of the personnel listed below, was charged by the Deputy Director of Operations on May 9, 2002 to perform an Accelerator Readiness Review (ARR) of the operation of the Tandem to Booster (TTB) Line with low mass ions. In addition, a related part of this review was to confirm the operation of RHIC with deuterons and other ions. The purpose of this review was to ensure that the required administrative controls and engineered safeguards committed in previous reviews to operate in these modes safely have been provided by the Collider Accelerator Department.

This review was conducted in compliance with the provisions of DOE Order 420.2, *Safety of Accelerator Facilities* and the Brookhaven National Laboratory Accelerator Safety Subject Area.

Committee member signatures below denote concurrence with findings and recommendations identified in this report.

Casey, Robert (NSLS)

W. R. Casey 10/3/02

Davis, Mark (ES):

Mark C. Davis 10/3/02

Monahan, Terry (SHS):

T. Monahan 10/3/02

Stein, Steve (QP&SO):

Steven Stein 10/3/02

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Appendices

1. ARR Team Appointment Memo dated 5/9/02 from Deputy Director for Operations
2. Memo dated 2/15/02, D.I. Lowenstein to T. Sheridan, “Request for Two ARRS”
including Commissioning Plans
3. The ARR Plan of Action for TTB Review
4. Collider Accelerator Department Presentation at Opening Meeting
5. Summary Reports of ARR Team Members

Executive Summary

The Accelerator Readiness Review Team (ARR) for the operation of the Tandem to Booster (TTB) with low mass ions was appointed by the Deputy Director for Operations on May 15, 2002. A *Plan of Action* describing the ARR approach for this review was prepared in compliance with the Implementation Guide for DOE Order 420.2, Safety of Accelerator Facilities and the BNL Accelerator Safety Subject Area.

The ARR process started on August 14, 2002 with a presentation and tour provided by Collider-Accelerator Department (C-AD). The ARR Committee conducted the evaluation of the facility through document review, interviews, and facility inspections. Summary reports of the individual team members' activities were prepared and are contained in this document.

It is the consensus of the ARR Team that the C-AD conducted a comprehensive review and all provisions of the safety assessment document are being addressed. Adequate controls and policies will be in place to transport beam safely from the Tandem to the Booster. In addition, C-AD has established limits for light and heavy ion operation in RHIC consistent with the approved Accelerator Safety Envelope and a process for review to ensure that operations are conducted consistent with it. A number of procedures and actions have not been completed at the time of this review that will need to be in place prior to the start of routine deuteron transport to Booster. This Team will monitor progress in completing these items and will recommend approval once all issues have been closed.

Introduction

Background

The Tandem Van de Graff has operated as a part of the heavy ion injection process for AGS since the late 1970s. Previously, there had been restrictions on transport of low mass ions through the existing tunnel connecting Tandem to the AGS Complex because of the potential for excessive radiation levels above the berm in the event of fault conditions. In recent years, because of significant programmatic interest in utilizing deuterons in the RHIC storage rings, the issue of deuteron transport in the TTB line was re-evaluated in an unreviewed safety issue (USI) report prepared by the C-AD entitled “Radiation Hazards from Low Mass Ions in the TTB”. The evaluation concluded that deuterons could be safely transported to Booster provided that shielding was increased and additional improvements described below were completed.

The USI document was reviewed and approved the C-AD Radiation Safety Committee (RSC), and subsequently reviewed and accepted by the Laboratory ESH Committee. In addition, an Accelerator Safety Envelope was developed based on the safety assessment and has been approved by C-AD management and the Lab ESH Committee. These documents have been accepted by the Laboratory Deputy Director for Operations and have been forwarded to the Manager of the DOE Brookhaven Area Office for final approval. It is the Review Team’s understanding that the Area Office will approve the ASE following successful conclusion of this ARR.

This ARR team was appointed by the Deputy Director for Operations on May 15, 2002 (see appendix 1) to confirm the implementation of C-AD commitments made during prior reviews.

Organization

The operation of the Tandem is the responsibility of the Collider Accelerator Department and is subject to C-AD requirements for routine operation. The C-AD Chair has ultimate responsibility for the operations, and the Tandem Group Leader has direct responsibility to operate the facility in accordance with the ASE and the operational procedures developed to ensure implementation of C-AD and BNL requirements. The Group Leader is responsible for the development of the radiological fault study plan that will define the activities to be conducted during the initial period of deuteron operation. The C-AD Radiation Safety Committee is responsible to review and approve the safeguards and operational requirements associated with deuteron transport and to approve the final check-list which must be completed prior to operation.

A detailed breakdown of departmental responsibilities for the preparation of the deuteron operation is provided in the “Acceptance Plan for Operation of the TTB Line with Low Mass Ions and RHIC with Deuterons” (see appendix 2).

Scope

The scope of the ARR Team's charge is to determine if the C-AD has completed all requirements and is prepared to safely transport deuterons from Tandem to Booster, and subsequently accelerate and store the deuteron beam in RHIC. The conduct of this review is based on BNL

requirements and DOE Order 420.2, “Safety of Accelerator Facilities” and the associated Implementation Guide. It should be noted that the ARR process is not designed to evaluate the adequacy of the SAD and the associated USI for deuterons in TTB, but is intended to confirm accomplishment of commitments made in the SAD and associated documents. A more complete description of the scope of the review is provided in the ARR Team Plan of Action (see appendix 3).

In order to reach a readiness determination for deuteron operation, the ARR Team assessed the following topics:

1. Resolution of Department internal reviews and operational readiness findings
2. Status of interlock system installation and testing
3. New operational procedures for deuteron operation
4. Operator training & qualification for new procedures
5. Safety assessment commitments for:
 - shielding
 - critical devices
 - access control
 - radiation monitoring
6. The commissioning plan & fault study results
7. The ASE for Tandem
8. The ASE for Booster, AGS, and RHIC with regard to acceleration and storage of deuterons

ARR Team

The ARR team consisted of five members - their affiliation and primary areas of review are listed below. The primary Point of Contact for the C-AD was Ed Lessard.

Name	Affiliation	Primary Responsibility
R. Casey (Chair)	NSLS Department	Radiological
M. Davis	Environmental Services Division	Environment, Operations & Maintenance
T. Monahan	Safety & Health Services Division	Interlock Safety
S. Stein	Quality Programs & Services Office	Training & Quality

P. Kelley from the local Brookhaven Area Office of the DOE was aware of the ARR process and was point of contact for DOE related issues.

Specific areas assigned to each team member are shown in Table I below:

Table I
Breakdown of Assignments

	Casey	Davis	Monahan	Stein
Safety Assessment Document	a	a	a	a
Commissioning Plan	x	a	a	a
Operational Readiness Evaluation		a	x	
Interlock Plan	a		x	
Maintenance	a	x	a	
Training & Quality Assurance	a	x	a	x
Operational Procedures	a	x	a	x
Accelerator Safety Envelopes	x	a	a	a
Environmental Issues		x		
Interviews	x	x	x	x
Field verification	x	x	x	x

“a” indicates secondary responsibility; “x” indicates primary responsibility

The review officially began on August 14, 2002 with an introductory presentation provided by C-AD personnel (see appendix 4). The majority of interviews and inspections were conducted during the week of September 9th, 2002.

Guidance for the ARR process was provided by DOE Order 420.2 Safety of Accelerator Facilities; the draft Accelerator Safety Implementation Guide and the BNL SBMS Subject Area on Accelerator Safety.

Conclusions

It is the consensus of the ARR Team that the Collider Accelerator Department has conducted a comprehensive review and all provisions of the safety assessment necessary for deuteron operation have been incorporated into facility and department practice. Adequate controls and policies will be in place to transport beam safely from the Tandem to the Booster. In addition, a basis for deuteron and other light ion utilization in RHIC has been established, and a review process involving the C-AD Radiation Safety Committee has been established to ensure implementation of appropriate requirements.

Accelerator Readiness Summary Reports were prepared by each ARR team member and are attached in appendix 5. At the time of this review a number of procedures and actions have not been completed that will need to be in place prior to the start of routine operations. The summary reports identify a number of pre-start issues that will need to be addressed by C-AD management and are listed in Recommendations below. C-AD management is well aware of the open issues.

Brief summaries of principal topic areas are provided below.

A **TTB Safety Assessment** has been prepared and approved by C-AD and Laboratory ESH Committee. This issue was addressed as an unreviewed safety issue by C-AD and the documentation will be incorporated into current safety assessment documents during planned updates.

A **TTB Accelerator Safety Envelope** has been prepared and approved by C-AD management. This document has also been reviewed and accepted by the Laboratory ESH Committee and Laboratory management and it has been formally transmitted to the Manager of the Brookhaven Area Office. Formal approval of the ASE by DOE awaits completion of this ARR. It is understood that the ASE is acceptable to DOE and that there are no issues that prevent approval following completion of this ARR. Implementing procedures have been drafted for control room and other staff to ensure compliance with the ASE requirements.

Operational safety limits for energy flux per hour have been established for Booster, AGS, and RHIC. The C-AD has established a process to ensure that the ASE limits will be met for the introduction of deuterons into Booster, AGS, and RHIC. The Liaison Physicists for Booster and AGS have reviewed deuteron operation and established that the operational safety limits for energy flux will be met with deuteron operation. In addition the C-AD RSC has reviewed acceleration and storage of deuterons in RHIC storage of deuterons and approved planned operations. It should be noted that previous ARRs for RHIC had placed restrictions on deuteron operation. The current process established by C-AD is adequate to ensure compliance with the ASE and the previous restriction on deuterons or other light ions is lifted by this review.

A **TTB Acceptance Plan** has also been prepared and approved by C-AD management. This document defines the elements necessary for transport of deuterons from Tandem to Booster.

The **shielding upgrade** specified in the safety assessment for the berm has been provided. A fault study under controlled conditions and limited current has been authorized by the Deputy Director for Operations and will be conducted prior to routine operation to examine the adequacy of the shielding addition that has been made. Radiation levels in portions of the control and target rooms will also be assessed during the initial deuteron operation. The ARR team will want to review the results of the fault study as part of the verification process.

A comprehensive review of radiation safety issues associated with deuteron operation was conducted by the C-AD Radiation Safety Committee. A checklist containing all required items for deuteron operation will be established and approved by the RSC Chair. All items identified in the checklist must be completed prior to C-AD approval to begin deuteron transport.

Upgrades in the Tandem and TTB line **Access Control** system were identified in the safety assessment documents as necessary. These upgrades have been installed. Review of the **TVDG interlock/access control system** has verified that due diligence was employed in the design and implementation of the system. TVDG & C-A staff members involved in this process are very knowledgeable with years of experience in development and implementation of Interlock/Access Control systems. Documentation needs to be reviewed and approved prior to light ion operation and system compatibility between the new and old systems must be tested.

A number of new or modified **operational procedures** are required for deuteron operation and transport to the TTB. Currently, these procedures are still under development and must be approved and issued by C-AD management prior to routine operation.

Limits on deuteron beam energy and intensity were identified in the safety assessment as required for safe operation. The limit on deuteron beam energy has been provided through a current limiting device on the 90° bending magnets into the TTB line which ensures that deuterons with energy greater than 12 MeV will not be transported into the TTB line. Intensity limits will be provided through the monitoring of scattered radiation from a beam profile monitor. Redundant “chipmunk” radiation monitors have been installed to monitor the scattered radiation and will be interlocked into deuteron operation. Both of these devices have been installed and are ready for final operational adjustments. Proper set-up of these protective devices must be confirmed and will be included in the RSC check-list.

Emergency preparation for deuteron runs was evaluated. No changes in current plans are required.

Potential **environmental impacts** were adequately considered and evaluated for deuteron operations. Established controls are adequate for these operations.

Safety and health conditions were examined during the tour of the facility and in later interviews. C-A/TVDG management has well-established mechanisms for evaluating and providing safe working environment for personnel. It is recommended that a comprehensive physical inspection of the facility take place prior to the beginning of routine operation with deuterons. In addition, two issues involving frequency of Tier 1 inspection and grounding of beam line components need to be re-examined.

In addition, internal C-A groups also evaluated issues for deuteron transport from TTB. All pre-start issues identified from the various internal reviews and final inspection must be resolved prior to approval for deuteron operations.

Maintenance activities were reviewed and found to be coordinated and controlled in accordance with established C-A policies and procedures.

The **Personnel Qualification Requirements** for the operations staff have been described in the various facility documents. The C-AD has a comprehensive program for qualification of responsible personnel. Training and qualification of personnel responsible for the deuteron operation is awaiting completion of new procedures and other program documents.

Recommendations

A number of safety and operational issues were open at the time of the ARR Team review and will need completion prior to BNL approval to begin routine operations. All items identified as pre-start will require verification by the ARR team.

1. C-AD must complete analysis of the fault study to verify adequacy of shielding for deuteron operation.
2. All critical procedures identified in the safety assessment must be completed and approved, and training provided and documented for operations personnel.
3. C-AD must complete verification and validation for compatibility between the old and new interlock systems.
4. All operational items currently being tracked by C-AD for deuteron operation must be completed prior to ARR approval.
5. Prior to beginning routine deuteron operations, the Tandem and TTB line require a comprehensive physical inspection. All pre-start findings from this inspection will need to be added to the current C-AD listing of open issues for TTB and closed prior to routine operations.

The following items are called to the attention of C-AD management for re-evaluation. However, they are not subject to resolution prior to transport of deuterons to Booster.

6. C-AD should address grounding of beam-line components, as the components themselves can not be relied on for an assured electrical grounding path.
7. The twice yearly Tier I schedule for this facility should be reevaluated.

Readiness Determination

The ARR team has determined that the C-AD has conducted comprehensive reviews of the Deuteron TTB transport and has taken steps to incorporate all commitments made in the safety assessment into the facility and operational programs. However, a number of issues remain open at the time of this review – therefore, the recommendation to approve the start of routine operations awaits verification of closure of these items. The Team will monitor progress at the facility until all issues identified in this report have been verified, and will provide a follow-up letter to the Deputy Director at that time.


Appendix 1

ARR Team Appointment Memo dated 5/9/02 from Deputy Director for Operations

BROOKHAVEN
NATIONAL LABORATORY

managed by Brookhaven Science Associates
for the U.S. Department of Energy

Memo

date: May 9, 2002
to: D. I. Lowenstein
from: T. Sheridan 
subject: Request for Two Accelerator Readiness Reviews

As requested in your memorandum of February 15, 2002, I have appointed an Accelerator Readiness Review Team. This team will participate in the two reviews for the Booster Applications Facility (BAF), the operation of the TTB Line with Low Mass Ions, and the Operation of RHIC with Deuterons. The team will consist of five individuals:

W. R. Casey, NSLS, Chairman of the ARR Team
J. Wishart, Chemistry
M. Davis, ESD
T. Monahan, SHS
S. Stein, QA

The ARR's will be conducted in accordance with the SBMS subject area concerning Accelerator Readiness Reviews.

Attachment

CC: M. Butler
P. Kelley
E. Lessard
ARR Team

Appendix 2

Memo dated 2/15/02, D.I. Lowenstein to T. Sheridan, "Request for Two ARRS" including Commissioning Plans

BROOKHAVEN


NATIONAL LABORATORY

Building 911
P.O. Box 5000
Upton, NY 11973-5000
Phone 831 344-4811
Fax 831 344-5954
Lowenstein@bnl.gov

managed by Brookhaven Science Associates
for the U.S. Department of Energy

date: Friday, February 15, 2002

to: T. Sheridan

from: D. I. Lowenstein 

subject: Request for Two Accelerator Readiness Reviews (ARRs)

Memo

The C-AD is requesting that you commence two ARR's on the dates given below. We feel the same ARR team could handle these two ARR's efficiently. The two accelerator readiness reviews are for:

ARR 1 - Commissioning and Operation of the Booster Slow Extraction, Booster Dump/Catcher at D Section, Booster Applications Facility (BAF) Beamline and Target Area Using Beams From Either Linac or TVDG, and Commissioning and Operation of BAF Support Buildings

ARR 2 - Operation of TTB Line With Low Mass Ions and Operation of RHIC With Deuterons

ARR 1 should begin August 1, 2002. I note that for the purpose of allowing sufficient time for the ARR Committee's validation effort, two separate commissioning modules and one operations module are envisioned for ARR 1:

- The first ARR 1 module should start August 1, 2002 and is for achieving readiness for Booster Slow Extraction, Booster Dump, and BAF Line commissioning. It is planned that the ARR committee complete their report on or about September 1, 2002.
- The second ARR 1 module should start January 1, 2003 and is for commissioning experimental equipment at the BAF. It is planned that the ARR complete their report for this module on or about February 1, 2003.
- The third ARR 1 module should start March 1, 2003 and is for achieving readiness for routine operation of Booster Slow Extraction, Booster Dump and the BAF with associated experiments. It is planned that the ARR complete their final report on or about April 1, 2003.

I attach the BAF Commissioning and Acceptance Plan that contains more detail about our Departmental approach to preparing for the ARR.

ARR 2 should begin September 1, 2002. The ARR should be able to review a limited set of changes to TVDG/TTB operations and recommend deuteron operation in TTB and RHIC by October 1, 2002. I plan on getting DOE approval for operation of TTB with low-mass ions and RHIC with deuterons by November 1. The limited changes to TTB/TVDG are upgraded shielding and upgraded engineered safety system for radiation protection. The documents that address deuteron-running mode are the draft Accelerator Safety Envelope (ASE) for TVDG/TTB and Unreviewed Safety Issue (USI) 3 for the TTB.

I attach the Acceptance Plan for operation with deuterons that contains more detail about our Departmental approach to preparing for the ARR.

The BAF SAD and draft ASE for BAF are available via the web, as are USI3 for TTB and the draft ASE for TVDG/TTB. These documents have been reviewed and recommended for approval by the Laboratory Environmental, Safety and Health Committee. I note that these documents have been previously forwarded to the DOE Brookhaven Area Office. They are available on the C-AD intranet and access privileges can be arranged for interested parties, who may be outside the firewall.^{1,2}

* * *

Copy to:

M. Butler
P. Kelley
E. Lessard
A. McNerney
P. Pile
T. Roser

Attachments:

1. BAF Commissioning and Acceptance Plan
2. Acceptance Plan for Operation of TTB with Low Mass Ions and RHIC with Deuterons

¹ http://www.cadops.bnl.gov/AGS/Accel/SND/tvdg_ttb_usi.htm

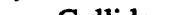
² http://www.cadops.bnl.gov/AGS/Accel/SND/baf_sad.htm

Acceptance Plan for Operation of the TTB Line With Low Mass Ions and RHIC With Deuterons

February 15, 2002

Prepared By

E. Lessard

Approved By: 
Collider-Accelerator Department Chair

Approval Date: 2/15/02

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I. Introduction

This acceptance plan describes necessary activities to be completed by the Collider Accelerator (C-A) Department prior to the ARR and commencement of routine operations of the TTB Line and RHIC with deuterons. It is intended that this acceptance plan help the C-A Department prepare for an appropriate readiness review as required in DOE Order O 420.2, Section 5 b. An appropriate Accelerator Readiness Review (ARR) must be conducted following the declaration of readiness for routine operations. The ARR report must support the decision by the DOE Field Office to approve the commencement of routine operations.

This plan is intended to ensure the C-A Department avoids unsafe or environmentally unsound operations. It is noted that routine operation of the TTB and RHIC with deuterons may be concurrent with other operations; e.g., the fixed-target program in Building 912. From an operations standpoint, deuteron operations is viewed as a portion of a spectrum of operations in which machine physicists and shift-based operations personnel work out of a single Main Control Room (MCR) in Building 911. The role of the physicists and operators located throughout the complex is to achieve efficient, safe, and environmentally benign conveyance of deuterons in the machines and transfer lines during all operations.

C-A Department staff and Users are subject to the requirements of the Collider-Accelerator Conduct of Operations Agreement. The Conduct of Operations Agreement requires the on-duty Operations Coordinators be responsible for operation of the Collider-accelerator complex. The operations staff consists of Operations Coordinators and Operators, as well as personnel from operations-support groups under their purview. Operations staff is trained, and only qualified personnel execute operation of the Collider-Accelerator complex. All authorizations, all permanent or temporary procedures, all Accelerator Safety Envelopes or Operational Safety Limits, and all responses to emergencies or occurrences must follow the formal processes identified in the Conduct of Operations Agreement. The BNL Directorate and the C-A Department management hold this understanding of the Conduct of Operations Agreement for the purposes of safe and environmentally sound operations.

II. Scope

The scope of this plan covers acceptance for routine deuteron operations in the TTB and RHIC. The plan is intended to help prepare for the following specific issues that will be verified by the ARR:

- Procedures, administrative controls, personnel training and qualification relevant to routine operations with deuterons are in place
- Engineered safety system for radiation protection in the TVDG and in the TTB tunnel are approved by the RSC and tested
- Shielding changes for TTB are completed

- Use of deuterons in RHIC is within the parameters given in the existing RHIC ASE

It is noted that the upgraded engineered safety system for radiation protection at TTB/TVDG is similar in design to those used for the RHIC. The system includes beam crash, access control, radiation monitors and critical devices. Additionally, it is noted that the earth berm at TTB has been raised to meet a minimum thickness of three feet.

III. Relevant Documents Available On-line

- TVDG Safety Assessment Document
- TTB Safety Analysis Report
- Proposed TVDG/TTB Accelerator Safety Envelope
- Collider-Accelerator Department Conduct of Operations
- Collider-Accelerator Department Operations Procedures
- Unreviewed Safety Issue 3 for TTB
- Training and Qualification Plan
- Quality Assurance Procedures
- Configuration Management Plan for C-A Access Control System
- Procedure for Review of Shielding Design
- Procedure for Unreviewed Safety Issues

IV. Conduct of Operations

All staff will be working under the procedures and authorizations prescribed by the existing Collider-Accelerator Conduct of Operations.

V. Training

The existing system for training, which can be audited, is maintained by the Collider-Accelerator Department Training Group. Records are maintained in BTMS.

BTMS job title relevant to routine operations and the minimum numbers of qualified personnel required for routine operation are:

- MCR Operations Coordinator, AD-510 (1 per shift)
- MCR Operator, AD-560 (1 per shift)
- Tandem Van de Graaff Operator, AD-012/AD-014 (1 per shift)
- C-A Radiological Control Technician, RP-01 and AD-520 (1 per shift)
- Collider-Accelerator Support, AD-570 (1 per shift)

VI. Operations Schedule

Operating Items for TTB and RHIC Using Deuterons, Persons Responsible, and
Scheduled Readiness Date

SCHEDULE: Operate TTB and RHIC with deuterons on or about November 1, 2002.
DESCRIPTION: New TTB/TVDG engineered safety equipment will be operated with deuteron beam in the TTB line. The shielding above the TTB line will have been raised to a minimum three-foot thickness. The RHIC will operate with deuterons.
OPERATING REQUIREMENTS (Persons Responsible) <ul style="list-style-type: none">• All related RSC items are closed out (D. Beavis)• Critical devices, beam current monitors and reach-backs for radiation protection have been established (D. Beavis)• The access control system is operational and tested (A. Etkin, N. Williams)• New sweep procedures are complete (C. Carlson, P. Ingrassia)• New TVDG operations procedures are complete (C. Carlson, J. Alessi)• Fault Study Plan prepared (J. Alessi)• RSC Check-Off List prepared (J. Alessi)• Accelerator Safety Envelope for TVDG/TTB is complete (E. Lessard)• Training records for operations staff are complete (J. Maraviglia)• Assure deuteron operations in RHIC are within RHIC ASE (A. Stevens, D. Beavis)

VII. List of New/Updated Procedures and/or Tasks Required for Operational Readiness (Person Responsible)

(E. Lessard)

OPM 2.5.1, Operational Safety Limits for Tandem Van De Graaff

OPM 2.5.2, RHIC Accelerator Safety Envelope Parameters (Revised)

(P. Ingrassia)

OPM 4.56. Number to be determined, TVDG Sweep Checklist

OPM 4.56. Number to be determined, TTB Sweep Checklist

(N. Williams and A. Etkin)

OPM 4. Number to be determined, TVDG/TTB Security Gate Subsystem Check

OPM 4. Number to be determined, TVDG/TTB Crash Subsystem Test

OPM 4. Number to be determined, TVDG/TTB Critical Response Subsystem Checklist

OPM 4. Number to be determined, Confirmation of Proper System Operation of PASS for TVDG/TTB

(N. Williams and J. Alessi)

- Add harp and dual Chipmunk to limit beam current at TVDG

- Locate harp (or equivalent) to create ~15 mrem/h at 100 nA
- Set Chipmunk interlocks at ~25 mrem/h
- Limit field in bypass dipoles for beam from MP6 to TTB
 - Use equivalent method to limit beam energy from MP7 to TTB if MP7 is used
- Add dual set of door interlocks in the TVDG accelerator room
 - Mechanical equipment room
 - TVDG control room
 - Target Room 4
 - TTB gate
 - Downstairs electrical equipment room
 - Downstairs mechanical equipment room

(J. Alessi)

- Ensure TVDG operators are trained in new procedures
- Create operation procedures in OPM Chapter 12 to
 - Limit hourly average deuteron currents to 200 nA
 - Limit terminal voltage to 6 MV
 - Limit dc average current to 200 nA or less
 - Restrict deuteron source to be MP6 only
 - Respond to Chipmunk alarms and interlocks
 - Disable 2nd set of door interlocks in TVDG
 - Minimize use of Faraday cups in TTB

(D. Beavis and J. Alessi)

- Issues to be checked at TVDG by RSC
 - Redundant interlock string switched in for deuteron operations
 - Bypass-line dipole fields are limited
 - Beam intensity monitor is locked in the inserted position
 - Chipmunk interlocks are switched in
 - The target-room-opening shields for scattered beam are in
 - The shielding at beam opening to Target Room 1 is installed
 - Entry into a TVDG tank requires a check for contamination by RCT
 - A fault study at the NW corner of Tandem Control Room is performed and evaluated
 - A fault study near Rutherford Drive and TTB is performed and evaluated
 - The earth shield along TTB is 3 foot thick or more
 - Two beam stops have been added at low energy end of MP6
 - Two beam stops have been added at low energy end of MP7
 - Logic and testing of changes to ACS at TVDG/TTB have been reviewed and approved
 - New ACS wiring, logic and testing is documented
 - All changes to existing ACS are configuration controlled
 - The redundant ACS in TVDG is a QA1 system

VIII. Responsibility Matrix

Acceptance Plan Element	Training - Records, Coordination	Fault Study Plan	Fault Study Review	Sweep Procedures	Operations Procedures	Access Control System Review	RSC Checklists	USI and ASE for TVDG/TTB	Assure Deuterons Within RHIC ASE
Person(s) Responsible									
A. Etkin			X			X			
H. Kahnhauser						X	X		X
D. Beavis		X					X		
J. Alessi		X			X				
C. Carlson				X	X				
E. Lessard								X	
J. Maraviglia	X								
N. Williams						X			
P. Ingrassia				X					
A. Stevens									X

Appendix 3

The ARR Plan of Action for Deuteron Transport from Tandem to Booster

Deuteron Transport from Tandem to Booster (TTB)

Accelerator Readiness Review – Plan of Action

Objective: The objective of this review is to evaluate the preparation of the Collider Accelerator Department to safely transport deuterons from the Tandem Van De Graff to the Booster Accelerator. The Accelerator Readiness Review (ARR) process will verify that necessary programs have been developed, that appropriate personnel have been assigned and trained, that operations and relevant procedures have been approved, and that safety significant systems and controls are in place. The ARR shall be performed consistent with the requirements of the BNL Accelerator Safety Subject Area and DOE Order 420.2. It should be noted that the ARR process is not designed to evaluate the adequacy of the Safety Assessment Document (SAD), but rather is intended to confirm satisfactory closure of commitments made in the SAD and associated documents.

Methodology: The ARR Team shall verify that operational and ESH program commitments and requirements have been satisfactorily addressed through review of documents, interviews with responsible personnel and facility walk-down. The programmatic areas to be evaluated and responsibilities of each team member are defined in Table I below. Each team member will provide a brief summary of their review for inclusion into the TTB ARR file.

A Operational Readiness Evaluation administered by the Collider Accelerator Department and augmented with independent ESH personnel will be conducted prior to the closure of the ARR evaluation. This evaluation is an important adjunct to the ARR process - closure of these findings will be verified during the ARR.

Scope: The Tandem Van de Graff has safely accelerated and transported heavy ions to Booster for many years. Previously, transport of deuterons were not permitted because of the potential for increased radiation levels in controlled and uncontrolled areas. The purpose of this review will be to verify that the changes in engineered safeguards, administrative controls, and procedures necessary for deuteron operation have been provided as committed in the revised SAD. In particular, the Review team will focus on:

Scope of review

1. Resolution of Department internal reviews and ORE findings
2. Status of interlock system installation and testing
3. New operational procedures for deuteron operation
4. Operator training & qualification for new procedures
5. Safety assessment commitments for:
 - Shielding
 - critical devices
 - access control
 - radiation monitoring
6. The commissioning & fault study plan

7. The ASE for Tandem
8. Confirmation that ASE for Booster, AGS, and RHIC permit acceleration of deuterons

Schedule: The ARR will be conducted in during September, 2002 and is expected to be complete by September 30.

A report addressed to the Deputy Director of Operations with recommendations and conclusions will be prepared at the completion of the review.

ARR Team Members: Members of the ARR team and their primary responsibilities are as follows. A more detailed breakdown of the scope of each team member's work is provided in Table I.

Name	Affiliation	Primary Responsibility
R. Casey (Chair)	NSLS Department	Radiological
M. Davis	Environmental Services Div.	Environ. & Operational
T. Monahan	Safety & Health Services Division	Interlock Safety
S. Stein	Quality Management Office	Training & Quality

P. Kelley from the local Brookhaven Area Office of the DOE will participate as a team member in the review and will provide DOE oversight of the process and findings.

Ed Lessard of the Collider Accelerator Department will be the primary point of contact for the ARR team.

Table I

Breakdown of Assignments

	Casey	Davis	Monahan	Stein
Safety Assessment Document	a	a	a	a
Commissioning Plan	x	a	a	a
Operational Readiness Evaluation		a	x	
Interlock Plan	a		x	
Maintenance	a	x	a	
Training & Quality Assurance	a	x	a	x
Operational Procedures	a	x	a	x
Accelerator Safety Envelopes	x	a	a	a
Environmental Issues		x		
Interviews	x	x	x	x
Field verification	x	x	x	x

"a" indicates secondary responsibility; "x" indicates primary responsibility

The DOE participant will attend and partake in all portions of the review as desired.

Appendix 4

CAD Presentation at Opening Meeting

Deuterons at TTB and RHIC

Opening Meeting with ARR Team

August 14, 2002

Scope of Preparations for ARR

- Procedures
- Administrative controls
- Personnel training and qualification
- Engineered safety systems in TVDG and TTB
- Shielding changes for TTB
- Review of deuterons and other ions in RHIC

Modes of Operation

- Deuterons can originate from either Tandem
- TTB line delivers beams to the Booster
- Booster, AGS, and AtR deliver beam to RHIC
- Au ions and d collide in RHIC

Controls and Safety Systems

- Setup for beam in TTB will be via TVDG Control Room
- Controls for beam operations will be via MCR
- Upgraded safety systems are similar to those at RHIC
- Upgraded TVDG/TTB safety systems include:
 - Access control subsystems
 - Radiation monitors
 - Critical devices

ARR Committee Drivers

- ARR starts September 1, 2002
- C-AD achieves readiness for routine operation with d
- ARR committee report October 1, 2002

Training and Qualifications

- MCR Operations Coordinator (1 per shift)
- MCR Operator (1 per shift)
- TVDG Operator (1 per shift)
- RCT (1 per shift)
- CAS (1 per shift)

Major Requirements

- Upgraded TVDG/TTB engineered safety systems operating
- Shielding above TTB is 3-ft soil equivalent or greater
- RHIC has authorization to operate with deuterons and all other ions up to Au

Specific Responsibilities

- All related RSC items are closed out (D. Beavis)
- Critical devices, current monitors, reach-backs established (D. Beavis)
- The ACS is operational and tested (A. Etkin, N. Williams)
- New sweep procedures are complete (C. Carlson, P. Ingrassia)
- New TVDG operations procedures are complete (C. Carlson, J. Alessi)
- Fault Study Plan prepared (J. Alessi)
- RSC Check-Off List prepared (J. Alessi)
- Accelerator Safety Envelope for TVDG/TTB is complete (E. Lessard)
- Training records for operations staff are complete (J. Maraviglia)
- Deuteron and other ion operations in RHIC (A. Stevens, D. Beavis)

Specific Responsibilities

N. Williams and J. Alessi:

- Add harp or equivalent at TVDG
- Add dual Chipmunk to limit beam current at TVDG harp
- Set Chipmunk interlocks at -25 mrem/h
- Limit field in bypass dipoles for beam from MP6 to TTB
- Use equivalent method to limit beam energy from MP7, if used
- Add dual set of door interlocks:
 - TVDG accelerator room
 - Mechanical equipment room
 - TVDG control room
 - Target Room 4
 - TTB gate
 - Downstairs electrical equipment room
 - Downstairs mechanical equipment room

Specific Responsibilities

J. Alessi:

- Ensure TVDG operators are trained
- Create operation procedures in OPM Ch.12 to:
 - Limit hourly average deuteron currents to 200 nA
 - Limit terminal voltage to 6 MV
 - Limit dc average current to 200 nA or less
 - Restrict deuteron source to be MP6 only
 - Respond to Chipmunk alarms and interlocks
 - Disable 2nd set of door interlocks in TVDG
 - Minimize use of Faraday cups in TTB

Specific Responsibilities

RSC Checks

- Redundant interlock string switched in for deuteron operations
- Bypass-line dipole fields are limited
- Beam intensity monitor is locked in the inserted position
- Chipmunk interlocks are switched in
- The target-room-opening shields for scattered beam are in
- The shielding at beam opening to Target Room 1 is installed
- Entry into a TVDG tank requires a check for contamination by RCT
- A fault study at the NW corner of Tandem Control Room is performed
- A fault study near Rutherford Drive and TTB is performed
- The earth shield along TTB is 3-foot thick or more
- Two beam stops have been added at low energy end of MP6
- Two beam stops have been added at low energy end of MP7
- Logic and testing of ACS have been reviewed and approved
- New ACS wiring, logic and testing is documented
- All changes to existing ACS are configuration controlled
- The redundant ACS in TVDG is a QA1 system

List of New/Updated Procedures

(E. Lessard)

OPM 2.5.1, Operational Safety
Limits for Tandem Van De Graaff

OPM 2.5.2, RHIC Accelerator
Safety Envelope Parameters
(Revised)

(P. Ingrassia)

OPM 4.56. xx, TVDG Sweep
Checklist

OPM 4.56. xx, TTB Sweep
Checklist

(N. Williams and A. Etkin)

OPM 4. xx, TVDG/TTB Security
Gate Subsystem Check

OPM 4. xx, TVDG/TTB Crash
Subsystem Test

OPM 4. xx, TVDG/TTB Critical
Response Subsystem Checklist

OPM 4. xx, Confirmation of
Proper System Operation of
PASS for TVDG/TTB

Next Steps

- Tour
- Individual meetings between ARR Team and C-A staff

Appendix 5

Summary Reports of ARR Team Members

TTB ARR Evaluation Form

Topic: Access Control & Beam Interlocks

Date: 9/16/02

I. Evaluation Criteria :

The following control devices were established in the RSC reviews of TTB and documented in the SAD as required for TTB operation:

- Current limiters on transport line dipoles to limit deuteron energies to not greater than 12 MeV.
- Beam intensity monitor to limit deuteron current intensity to 200 nA.
- Redundant interlock loop on all gates
- Redundant critical devices

The purpose of this review is to confirm that these systems are installed and operational prior to TTB deuteron operation.

II. Records Reviewed:

Radiation Safety Commite Minutes – 7/3/01

Radiation Safety Commite Minutes – 10/5/01

CAD Unreviewed Safety Issue – “Radiation Hazards from Low Mass Ions in the TTB”

III. Interview Conducted:

A telephone interview was conducted with Neville Williams, CAD interlock Group Leader.

IV. Sites Visited:

Tandem accelerator enclosure and HITL line were visited.

V. Discussion of Results:

At the time of this review all the devices listed above have been installed and initially accepted. A final acceptance test is required for the redundant interlock loop. The current limiters for deuteron energy are in the process of being relocated to downstream of the 90 degree bend from Tandem into the HITL transport tunnel and will require testing and acceptance again.

VI. Conclusion:

Final tests and acceptance must be completed for each item. These items will need to be included in RSC check-list and confirmed prior to deuteron operation in Tandem.

VII. Recommendation

The RSC checklist must be prepared and completed before ARR validation can be completed.

Reviewer: W.R. Casey

ARR Evaluation Form Tandem Van de Graaff to Booster

Topic: Interlock Plan

Date: 9/27/02

I. Evaluation Criteria:

The following topics were assessed by conducting interviews, document reviews and inspections.

A. Ensure the design and implementation of the refined interlock system provides an appropriate degree of protection in accordance with ES&H Standard 1.5.3, Interlock Protection for Protection of Personnel.

B. Determine functional status of Access Control system.

C. Determine status of documentation and procedures for the interlock system and Access Control functions

- Exist & approved
- Accessible by personnel performing actions

D. Verify existence of a process for reviewing changes for impacts on hardware, procedures, training and un-reviewed safety issues.

II. Records Reviewed:

- Tandem Van de Graaff (TVDG) Relay Logic Division A
- ASSRC minutes on TVDG ODH

III. Interview(s) Conducted:

- N. Williams – Group Leader Access Controls
- C. Carlson – Operations Supervisor
- J. Alessi – Pre-injection Group Leader
- D. Meany – Access Controls Group

IV. Sites Visited: Identify any areas that were inspected

Toured the following areas:

- Tandem Van de Graaff floor & Control Room

V. Discussion of Results:

In order to complete this exercise several assessment methodologies were employed:

- documentation was reviewed with comparison to BNL ES&H Standards;
- interviews with cognizant CA & TVDG staff; and
- functional assessment of the system.

A. Ensure the design and implementation of the refined interlock system provides an appropriate degree of protection in accordance with ES&H Standard 1.5.3, Interlock Protection for Protection of Personnel.

- The existing TVDG interlock system consisted of a single logic chain (critical hazard as defined in ES&H 1.5.3, Interlock Safety for protection of Personnel), which is appropriate for heavy ion injection. This system will continue to be used in that mode for heavy ions.
- Light ion mode elevates that ES&H hazard to a catastrophic level as per 1.5.3, and therefore requires redundant interlock protection. The modified redundant chain provides an appropriate level of protection through the use of redundant beam stops.
- Design of the expanded interlock system has been reviewed and approved by CA's Radiation Safety Committee. This committee is the appropriate body to determine adequacy of the interlock system.
- Evaluation of the TVDG interlock and Access Control systems consisted of a review of the schematics for the newly installed portion of the interlock system (redundant chains) against the requirements of BNL's ES&H Standard 1.5.3.
- C-A and TVDG staff members interviewed were knowledgeable of the system, as several were involved in design, review and implementation of the system. The Interlock/Access Control system was built using the tried and true design philosophy employed in the AGS system. New components in the system were reportedly reviewed and approved by the CA Chief Electrical Engineer.
- The pre-existing TVDG interlocks will remain in operation. The redundant chain in addition to the older TVDG interlock system will be utilized during light ion operations. An administrative procedure regulates change of mode, which is controlled by two senior operations personnel. **Ensure administrative procedure is reviewed and approved prior to reliance on interlocks for light ion operation.**

B. Determine functional status of TVDG Interlock/Access Control system.

- The CA Access Control Group Leader (ACGL) maintains a interlock sub-system validation logbook of all V & V tests. These tests and documentation in this logbook is a crucial step in verifying functionality of the interlock system.
- V & V was performed and documented for each subsystem of the new redundant interlock system.
- As of the writing of this report, the final interface testing (old system with the new) was not performed. This testing is vital to ensure compatibility between the two systems. **Perform old & new system interface testing (V & V) and provide documentation to close out.**

C Determine status of documentation and procedures for the interlock system and Access Control functions

- Exist & approved
- Accessible by personnel performing actions

- A review/discussion was held with authors of required procedures to determine status of required documentation. A number of these procedures are not yet in place for light ion operation. Several documents as listed in the August 14, 2002 Opening Meeting presentation are in the review process while others have not yet been drafted. **Appropriate documentation (e.g., sweeps, mode control and interlock checks) must be reviewed and approved prior to commencement of operations.**

D. Verify existence of a process for reviewing changes for impacts on hardware, software and procedures.

- The C-A Department has established protocols for evaluation of hardware and software changes to the Access Control system. These OPMs have been established for configuration control management. **No issues.**

VI. Conclusion:

Review of the TVDG interlock/access control system has verified that due diligence was employed in the design and implementation of the system. TVDG & C-A staff members involved in this process are very knowledgeable with years of experience in development and implementation of Interlock/Access Control systems. Documentation should be reviewed and approved prior to light ion operation and system compatibility must be tested..

VII. Recommendations

- C-A/TVDG must review and approve all critical procedures/documentation with personnel trained to those procedures prior to light ion operation. (Pre-start)
- C-A/TVDG should complete V & V for compatibility between old and new interlock system. (Pre-start)

Reviewer: Terry Monahan

9/27/02

TtB Line Deuteron ARR Evaluation Form

Topic: Maintenance / Operations / Environment /Emergency Procedures

Date: 9/12/02

I. Evaluation Criteria

The following topics will be assessed by conducting interviews, document reviews and inspections.

A. Maintenance & Work Controls

- a. How are maintenance actions scheduled & controlled?
- b. Walk through/describe process of performing maintenance.
 - i. Scheduling
 - ii. Authorization to start work.
 - iii. Work status tracking.
 - iv. Post maintenance testing.
- c. How are the Engineered Safety Systems (ASE section 4) tests scheduled?

B. Emergency procedures.

- a. Any new/revisions to emergency procedures required for deuterons?
- b. Procedures authorized; training documented?
- c. Demonstrate how current on-duty personnel are fully qualified.

C. New OPM procedures completed/approved/training verified.

D. Environmental

- a. Have environmental issues been considered for this new operating mode?
- b. How is the requirement to sample closed loop deionized water before discharge implemented? (Reference SAD 4.3.2), (i.e., In a procedure, personnel knowledge, etc.)
- c. TtB and TVDG basement sump and alarms - routine testing (Ref. USI form).
- d. Monitoring wells and sampling schedule are reviewed periodically (Reference ASE 5.5.1).

II. Records Reviewed:

- a. C-A Unreviewed Safety Issue (USI) Form "Radiation Hazards From Low Mass Ions in the TTB" 11/18/91.
- b. TVDG Operators Orientation binder

- c. BNL memo, Paquette to Cirnigliaro 11/26/01; "Assessment of the Potential Environmental Impact of Transporting Deuterons in the Tandem to Booster Line".
- d. BNL Work Permit for drilling holes through wall.

III. Interview(s) Conducted:

- D. Paquette – ESD Ground Water Monitoring (9/9/02)
- C. Carlson - Tandem Operations Manager (9/10/02)

IV. Sites Visited: Identify any areas that were inspected

Toured the following areas:

- Tandem facility and TtB tunnel on 8/14/02.

V. Discussion of Results:

A. Maintenance & Work Controls

- Discussed process of performing maintenance at the Tandem facility.
 - 1. C. Carlson authorizes all work, unless delegated to a Tandem Supervisor.
 - 2. Personnel outside the Tandem group check in and out through the control room.
 - 3. C-A work controls or support groups are informed of planned maintenance as necessary.
 - 4. BNL Work Permits are used to plan and control certain work activities.
- Maintenance is planned and performed around facility operating schedule.
- Morning and afternoon meetings are held with operations personnel, where the following types of issues are discussed:
 - 1. Facility operations planned for the day
 - 2. Equipment status.
 - 3. Planned maintenance actions (performed by internal & external groups).
- Tandem uses a computerized tickler system to schedule & track routine maintenance, calibration & testing tasks, including the Engineered Safety Systems (ASE section 4) tests.

B. Emergency Procedures

- No new emergency procedures are required to be developed for running deuterons in TtB.
- Operations personnel are trained in procedure revisions by "reading & signing", with walkthroughs provided as necessary. Discussions are also held during the daily meetings.
- Procedures developed by the Tandem Operations group (C. Carlson) are reviewed by J. Alessi and then forwarded to required C-A personnel for review/signatures and incorporation into C-A online OPM.
- The *TVDG Operators Orientation* binder was reviewed. This binder contains documentation that each operations personnel has been trained in a specific procedure.

C. New OPM Procedures

- A few of the identified new OPM procedures required for TtB with deuterons operations have been drafted. Examples: The Tank Entry procedure has been drafted and is being reviewed by J. Alessi; the sweep procedures have been drafted and are in the review process.
- Many of the items identified in the C-A presentation for incorporation into OPM Ch. 12 procedures (Limits on terminal voltage, dc average current, etc.) will be captured in a single OPM procedure.

Recommendation: C-A must supply the ARR team with verification that the OPM procedures necessary for operation with deuterons have been fully approved, incorporated into the OPM, and that the appropriate personnel have been trained on the new procedures.

D. Environmental

- a. Review of the C-A Unreviewed Safety Issue (USI) Form "Radiation Hazards From Low Mass Ions in the TTB" 11/18/91 indicates that environmental issues (NESHAP reviews, soil activation, ground water contamination potential, etc.) were considered and evaluated.
- b. How is the requirement to sample closed loop deionized water before discharge implemented? (Reference SAD 4.3.2).

Because this sampling is primarily being performed as a precaution and tritium is not expected to be present in concentrations requiring control, the sampling requirement is performed based on individuals' (Group Leader & Supervisors) system knowledge. Note: If tritium levels are found to be increasing toward levels requiring tighter controls, a more formal means of ensuring the sampling requirement is performed may be warranted.

- c. Testing of the TtB tunnel and TVDG basement sump and alarms is not routinely performed or verified by the Tandem group. (Ref. USI form)
- d. The TVDG and TTB ASE section 5.5.1 states "Groundwater monitoring well locations and frequency of monitoring shall be reviewed periodically". However, based on BNL memo, Paquette to Cirnigliaro 11/26/01; "Assessment of the Potential Environmental Impact of Transporting Deuterons in the Tandem to Booster Line", monitoring wells do not exist and are not required.

Recommendation: Revise wording of ASE section 5.5.1 to eliminate the implication that monitoring wells and a sampling program current exist.

VI. Conclusion:

The following program areas associated with transporting deuterons in the TtB Line were determined to be in compliance with established BNL and C-A programs and procedures:

TTB ARR Evaluation Form

Topic: TTB ASE Review for Transport of Deuterons to RHIC

Date: 9/24/02

I. Evaluation Criteria:

BNL policy requires that accelerator operations be governed by an approved Accelerator Safety Envelope which is consistent with and derived from an approved safety assessment document. The purpose of this review is to determine that an approved ASE exists for deuteron transport and acceleration in Booster, AGS and RHIC from Tandem to Booster, and that processes are in place to ensure compliance with the operational safety limits.

II. Records Reviewed:

- CA Operations Procedure Manual, procedure 2.5 "Operations Safety Limits/ASE for AGS, Booster, and Linac"
- CA Operations Procedure Manual, procedure 2.5.2 - "RHIC Accelerator Safety Envelope Parameters"
- Memo dated 9/26/01 from A. J. Stevens to H. Kahnhauser, Subject: "RHIC ASE as a Function of Ion Species"
- Document entitled "Maximum Intensity and Energy of Deuterons in Booster and AGS" dated 9/27/02 by L.A. Ahrens & C.J. Gardner

III. Interview Conducted:

A telephone interview was conducted with Ed Lessard on 9/17/02, and again on 9/26/02. In addition, a telephone interview was conducted with Peter Ingrassia on 9/26/02. The purpose of these discussions was to review the documents listed above and to determine how confirmation of the energy fluence limits for Booster and AGS are addressed prior to injection into Booster.

IV. Sites Visited:

None

V. Discussion of Results:

The approved ASEs for these facilities have been written with limits relating to the maximum energy fluxes that can be accelerated within the tunnels and enclosures. The Booster limit is 5.4×10^{17} nucleons-GeV/hr. The AGS limit is 1.1×10^{19} nucleons-GeV/hr. The RHIC limit is expressed as the equivalent of 2.4×10^{11} equivalent gold ions at 100 GeV/nucleon, which has been demonstrated by Stephens to be equivalent to be a total energy of 4.8×10^{15} GeV per ring. Stevens has further expressed this energy limit for a variety of ions ranging from deuterons to gold. This analysis provides a mechanism for insuring that the energy limit established for storage of ions in RHIC can be interpreted over the range of ions that may be used in the future.

Furthermore, CAD has established requirements that the each ion species introduced into RHIC be reviewed with the Radiation Safety Committee to ensure that proper controls and procedures are available to ensure compliance with the RHIC circulating beam energy limit.

The responsibility for the confirming that the energy flux limits established in the ASE are met in Booster and AGS is assigned to the liaison physicist for each ring. An analysis by the Liaison Physicists has been documented which demonstrates that the use of deuterons in Booster and AGS will be accomplished within the ASE limits for each accelerator.

VI. Conclusion:

The CAD has established a process to ensure that ASE limits will be met for the introduction of deuterons into Booster, AGS, and RHIC.

VII. Recommendation

The analyses demonstrating compliance with the operational safety limits in Booster, AGS, and RHIC will need to be verified by the ARR prior to approval. (Note added – This document was produced and this issue was closed prior to the final report being issued.)

Reviewer: R. Casey

TTB ARR Evaluation Form

Topic: Radiation Safety Committee Review

Date: 9/16/02

I. Evaluation Criteria :

In this review I will seek to determine that the Radiation Safety Committee has reviewed the deuteron transport from TTB and that the recommendations of the committee have been closed.

II. Records Reviewed:

Minutes of the Radiation Safety Committtee of 7/3/01, 10/5/01, and 9/___/02 were reviewed

III. Interview(s) Conducted:

A telephone interview was conducted with Dana Bevis, Chair of the Radiation Safety Committee.

IV. Sites Visited:

None

V. Discussion of Results:

The RSC has met 3 times to evaluate the requiremetns for the safe transport of deuterons from tandem to booster. A list of rerquiremntns has been established that are being followed until closed by the Chair. A radiation safety checklist will be prepared which must be completely resolved before AGS Operations personnel will permit transport of deuterons from Tandem to Booster.

VI. Conclusion:

The proper reviews have been conducted, but many items remain open at this point and the RSC checklist has not been prepared at this point.

VII. Recommendation

Tthe RSC checklist must be prepared and completed before ARR validation can be completed.

Reviewer: W.R. Casey

Maintenance / Operations / Environment / Emergency Procedures. The following recommendations will further enhance these areas.

VII. Recommendations

- C-A must supply the ARR team with verification that the OPM procedures necessary for operation with deuterons have been fully approved, incorporated into the OPM, and that the appropriate personnel have been trained on the new procedures.
- Revise wording of ASE section 5.5.1 to eliminate the implication that monitoring wells and a sampling program current exist.

Reviewer: Mark Davis (ESD)

9/12/02

TTB ARR Evaluation Form

Topic: SAD & ASE Review

Date: 9/17/02

I. Evaluation Criteria :

BNL policy requires that accelerator operations be governed by an approved Accelerator Safety Envelope which is consistent with and derived from an approved safety assessment document. The purpose of this review is to determine that an approved SAD and ASE exist for deuteron transport from Tandem to Booster.

II. Records Reviewed:

- Memo Sheridan to Holland dated 12/3/01 "Tandem-to-Booster Line Unreviewed Safety Issue"
- Memo Rorer to Sheridan dated 11/15/01 "Tandem-to-Booster Line Unreviewed Safety Issue"
- Minutes of Lab ESH Committee Meeting 01-04 dated 10/17/01
- Presentation dated 10/17/02 by E.T. Lessard to Lab ESH Committee "Low Mass Ions in the Tandem to Booster Line"

III. Interview Conducted:

A telephone interview was conducted with Ed Lessard on 9/17/02.

IV. Sites Visited:

None

V. Discussion of Results:

The CAD presented the results of their safety evaluation of deuteron transport to Booster to the Laboratory ESH Committee on October 17, 2001. Included in the presentation was the proposed ASE for deuteron operation. The Committee unanimously accepted and recommended approval of the analysis and the ASE to the Deputy Director for Operations.

The Deputy Director for Operations formally transmitted the ASE to DOE for approval on 12/3/01. The Area Office has informally advised that the document is acceptable to them, but that they are holding final approval until the successful completion of the ARR.

VI. Conclusion:

An approved SAD exists and there are no apparent barriers to final approval by DOE of the ASE previously approved by CAD and Lab management.

VII. Recommendation

None

Reviewer: R. Casey

ARR Evaluation Form

Tandem Van de Graaff (TVDG) to Booster

Topic: Safety & Health

Date: 9/30/02

I. Evaluation Criteria:

The following topics will be assessed by conducting interviews, document reviews and inspections.

- A. Status of safety reviews performed for the TVDG.
- B. Facility Use Agreements (FUAs) and other facility specific information maintained.
- C. Ensure appropriate measures are in place to ensure continued protection of personnel.

II. Records Reviewed:

- FUAs for Building 901.
- ASSRC meeting minutes on TVDG ODH issues.
- Acceptance Plan for Operation of the TTB Line with low mass ions and RHIC with Deuterons 2/15/02

III. Interview(s) Conducted:

- C. Carlson – TVDG Operations Supervisor
- P. Cirnigliaro – CA Safety Group
- D. Beavis – RSC Chair

IV. Sites Visited: Identify any areas that were inspected

Toured the TVDG facility

V. Discussion of Results:

A. Status of safety reviews performed for the TVDG.

- The TVDG has operated for several decades now without major incident.
- Safety & Health related reviews were discussed for the TVDG (e.g., ODH issues by the ASSRC) and an acceptance plan drafted by CA.
- CA is planning on characterizing the magnetic fields around the TVDG magnets. This is a step in the right direction. **However during the opening meeting of the ARR for the TTB operation, a tour of the operating floor revealed lack of grounding for beam-line components and stands. The facility would probably benefit be an ORE type review by the ASSRC to assist in identification of S&H issues along with remediation plans.**

B. Facility Use Agreements (FUAs) and other facility specific information maintained.

- TVDG Facility Use Agreement appears to be up to date; but must be revised if the light ion operation exceeds operational limits defined in the current FUA.

C. Ensure appropriate measures are in place to ensure continued protection of personnel.

- The TVDG is included in the CA Tier I schedule. The facility is inspected twice a year, contrary to established Laboratory policy. Permission to inspect twice a year was reportedly given based on the rationale that CA had a large volume of areas in their program. **The number of facilities in the program as a basis for exemption to the quarterly inspection requirement should be revisited.**

VI. Conclusion:

C-A/TVDG management has well-established mechanisms for evaluating and providing safe working environment for personnel. Recommendations below should be addressed by the Department prior to operation

VII. Recommendations

- C-A /TVDG should address grounding of beam-line components as the components themselves can not be relied on for assured electrical grounding path.
- An ORE type walkthrough by the CA internal ASSRC would assist in identification of S&H issues that are not picked up during routine inspections.
- The twice yearly Tier I schedule for this facility should be reevaluated or provide for TVDG internal Tier I to supplement the CA inspection.

Reviewer: Terry Monahan

9/30/02